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(Abstract)

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CO_2 dissolution in formation water as dominant sink in natural gas fields

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A primary concern facing Carbon Capture and Storage (CCS) technology is the proven ability to safely store and monitor injected CO_2 in geological formations on a long-term basis. However, it is extremely challenging to assess the long-term consequences of CO_2 injection into the subsurface from decadal observations of existing CO_2 disposal sites.

Noble gases are conservative tracers within the subsurface, and combined with carbon stable isotopes, have proved to be extremely useful in determining both the origin of CO_2 and how the CO_2 is stored within natural CO_2 reservoirs from around the world [1,2]. This presentation will identify and quantify the principal mechanism of CO_2 phase removal in nine natural gas fields in North America, China and Europe. These natural gas fields are dominated by a CO_2 phase and provide a natural analogue for assessing the geological storage of CO_2 over millennial timescales. Our study highlights that in seven gas fields with siliciclastic or carbonate-dominated reservoir lithologies, dissolution in formation water at a pH of 5–5.8 is the major sink for CO_2 [2]. This pH range is obtained by modelling the carbon isotope fractionation that results from dissolution of CO_2(g) to varying proportions of H_2CO_3(aq) and HCO_3^-(aq). This is a major breakthrough as accurate subsurface pH measurements are notoriously difficult to obtain. In two fields with siliciclastic reservoir lithologies, some CO_2 loss through precipitation as carbonate minerals cannot be ruled out, but this is minor compared to the amount of CO_2 lost to dissolution in the formation water within the same fields.

Our findings imply mineral fixation is a minor CO_2 trapping mechanism within natural reservoirs and hence suggests long-term models of geological CO_2 storage should consider the potential mobility of CO_2 dissolved in water.

[1] Gilfillan et al., (2008) *GCA* **72**, 1174-1198.

[2] Gilfillan et al., (2009) *Nature*, **doi:10.1038/nature07852**